



ORACBA News

United States Department of Agriculture Office of Risk Assessment and Cost-Benefit Analysis

Safety Assessment and Risk Assessment Sometimes More Is Less

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U.S. Food and Drug Administration

Safety Assessment

The oldest formal decision process in regulating exposure to potentially toxic substances is fairly simple. This process, which is often referred to as the NOAEL/SF-UF (No-Observed-Adverse-Effect-Level/Safety Factor-Uncertainty Factor) procedure, begins with an experiment where a controlled exposure to the substance has no apparent or observable adverse effect. Application of SF-UF(s), typically composed of multiples of 10, produces a level of exposure that may serve as a regulatory standard such as an Acceptable Daily Intake (ADI), a Provisional Tolerable Weekly Intake (PTWI), Reference Dose (RfD) or Minimal Risk Level (MRL). Although it was first introduced by the U.S. Food and Drug Administration for the purpose

of regulating food additives, the NOAEL/SF-UF procedure is now widely used in the United States and throughout the world.

A primary attraction of the NOAEL/SF-UF procedure is the simplicity of its administration. However, while the calculation that is used to derive the "safe" level (or whatever name one wishes to give it) is readily apprehended, there are many areas of judgment involved in its application. As a result, the NOAEL/SF-UF procedure involves some art or opinion that may vary between individuals and institutions. These choices may revolve around both scientific issues and policy objectives.

A key feature of the NOAEL/SF-UF procedure is that at no point does it yield a quantitative prediction of harm. The NOAEL/SF-UF procedure is intended to establish safety. In a legal sense, the procedure often defines what the word "safe" means. That is, if an agency is given the task of determining "safety," whatever procedure the agency uses defines what "safety" means. Thus, the NOAEL/SF-UF procedure may be taken as the prime example of a "safety assessment paradigm," where scientific and policy issues are not differentiated. As a result, even if the calculation of an ADI/RfD/PTWI/MRL is straightforward and transparent, the rationale for the numbers used may not be transparent. For example, even if it is clear when a factor of 10 is to be applied, it may not be

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clear why the factor is 10.

Risk Assessment

Risk assessment as a formal process, distinct from safety assessment, is a more recent phenomenon. A risk assessment may start with the same data, but it does not produce the same result. Instead of a dose or a regulatory standard, a risk assessment produces a prediction, usually with some attendant uncertainty. In fact, one might stipulate that it must contain some uncertainty, otherwise there would be no risk. While the prediction may serve as the basis for a standard setting process, it is not itself a standard.

Ideally, a risk assessment should serve to separate science and policy. However, a formal uncertainty analysis is often essential to attaining this goal. Otherwise, the burden of proof or benefit of the doubt is liable to become a political football that becomes deeply embedded in the scientific dialogue. Including an uncertainty statement may make an already complex analysis more complex. Nonetheless, if the risk assessment is to serve as a fair statement of what is currently known about a particular problem, then a representation of the often partial nature of our knowledge is indispensable.

Uncertainty is no stranger to safety assessment. It is usually understood that the magnitude of the uncertainty factors increases with the degree of uncertainty because the NAOEL/SF-UF procedure was designed to be used to establish a high degree of certainty that a substance is safe (e.g., a food additive). However, in a safety assessment there is no attempt to state either how great the uncertainty is or precisely what the impact of the uncertainty is on the decision.

Since a risk assessment yields a prediction rather than a standard, it leaves the job of deciding when, what, and how to regulate unfinished. At least one more step is required that relates the information to some objective. This step may be a decision made

on a case-by-case basis (perhaps using a cost-benefit analysis) or it might be a long-standing codified policy. An example of the latter is the use of a policy standard of 10^{-6} in conjunction with cancer risk assessments to produce regulatory standards for food additives. If policy standards are developed, they do not necessarily have to be "acceptable" levels of exposure that may be very hard to regulate. Instead, policies can be "risk" standards that relate some expectation of harm to an action.

Safety Assessment as Risk Assessment

The safety assessment/risk assessment distinction that we have drawn is not universally recognized. In fact, there has been considerable effort aimed at "harmonizing" the distinction into dissolution. Central to this endeavor is the consideration of the NOAEL/SF-UF procedure as a process that yields a prediction rather than a regulatory standard. For example, it has been suggested that the ADI concept is flawed because:

In practice, the ADI is viewed by many (including risk managers) as an "acceptable" level of exposure, and, by inference, any exposure greater than the ADI is seen as "unacceptable."

Of course, this is precisely what Fitzhugh and Lehman had in mind. When applied to food additives, the ADI was the basis for a regulation. It was used to calculate how much of the additive could be added to food, with the acceptance of the agency as a matter of policy. In order to deal with this "problem," the ADI was renamed as the scientific term Reference Dose (RfD):

This strict demarcation between what is "acceptable" and what is "unacceptable" is contrary to the views of most toxicologists, who typically interpret the ADI as a relatively crude estimate of a level of chronic exposure which is not likely to result in adverse effects to humans. The ADI is generally viewed by

risk assessors as a "soft" estimate, whose bounds of uncertainty can span an order of magnitude.

Even though the basic procedure remained unchanged, the NOAEL/SF-UF procedure was recast from a process that yields a level of regulatory significance to a process that yields an estimate of a threshold dose. Following this declaration, there has been an effort to characterize the uncertainty of the threshold dose, and to employ the RfD as a dose-response component of a National Academy of Sciences risk assessment paradigm.

In our view, the attempt to remake the NOAEL/SF-UF into a risk assessment procedure cannot possibly work, because it was never designed for such a purpose. The essential difficulty is that a dose is not a risk. Even if a probability is attached to the dose, the dose is not the harm. This basic failing yields many shortcomings:

- There can be no uncertainty analysis concerned with the possibility that there is no threshold since the definition of the RfD assumes that there must be one.
- Even if there is a threshold and the RfD is an accurate measure, the analysis does not yield a prediction of what may happen if the threshold is exceeded.
- The benefit of administrative simplicity is lost when an uncertainty analysis is introduced into the RfD derivation process.

- In spite of the “scientific” posturing and change in terminology, the RfD is typically employed as a regulatory standard. This may be attributed to the fact that it provides no information that policymakers can use.

More May Be Less

Referring to the NOAEL/SF-UF procedure as a risk assessment suggests that, even though it is simpler and more superficial, it is functionally equivalent to a formal process for calculating the probability of harm. Since the NOAEL/SF-UF procedure is commonly viewed as a standard setting process, this seeming equivalence may lead some to believe that a risk assessment also directly leads to the identification of a regulatory standard. As a further result, if an agency undertakes a risk assessment, it may not be commonly understood that there also must be a risk management process that takes partial or uncertain information to produce a decision about how the agency will act. Even though a risk assessment may require considerably more effort than a safety assessment, there are still some difficult choices to be made at the end. A risk assessment does not really create these choices—it simply makes them more obvious.

Citations

Lehman, A.J. and O.G. Fitzhugh. 1954. Association of Food Drug Officials. USQ Bull. 18: 33-35.

Price et al. 1997. *Risk Analysis*. 17:427-37.

World Wide Web. <http://www.epa.gov/iris/rfd.htm>, section 1.2.2.2.2

Director's Corner by Nell Ahl

As risk analysis for use in agricultural and food safety decision-making matures, each increase in

knowledge seems to bring even more questions to the fore. The food safety community is particularly

concerned, at the present, with the Precautionary Principle and its use in risk management. The Precautionary Principle describes a potential decision rule for risk managers to use “to address potentially negative effects resulting from a phenomenon, product or procedure where scientific evidence is insufficient, inconclusive or uncertain.” Much of the discussion between the European Union and the U.S. revolves around the use of the Precautionary Principle. Understanding and appropriately using the Precautionary Principle is also an issue, though less public at present, for much agricultural decision making regarding international trade as well as domestic hazards.

The Precautionary Principle calls for prompt protective action rather than delaying the beginning of mitigations until scientific uncertainty is resolved. In applying this principle for risk management, a decision-maker wants to avoid committing a Type II error: that is, making a decision as if there are no adverse effects from a hazard when there actually are. These are career-limiting errors. It is better to be safe than sorry. For that reason, risk managers/decision makers tend to commit Type I errors: that is, assuming adverse effects when there are none. In summary, it is better to be safe than sorry.

There are several instances in which the Precautionary Principle should be more carefully defined or considered. First, when an exposure results in beneficial as well as hazardous consequences, reduction of the exposure could generate an adverse effect. An example under current debate is the Food Quality Protection Act being implemented by the EPA. No one claims that eating pesticides is good for health. On the other hand, pesticides used in the production of fresh fruits and vegetables undoubtedly have resulted in abundant produce at affordable prices in the grocery store. Consumption of fresh fruits and vegetables is recognized as having many human health benefits. In addition, the stress of insect predation increases the production of mycotoxins which can be serious

human health hazards; pesticides mitigate this effect of mycotoxin production. When exposure results in both positive and negative consequences, a Type I error for consideration of the adverse effects may also be a Type II error associated with reduction of the beneficial effects. When canceling the registration for some pesticides, the effects on the abundance and affordability of produce should be considered as well as pesticidal effects on naturally occurring toxins. If no pesticide substitutes are available for particular crops, then that fruit, vegetable, or grain could be lost to consumers or become prohibitively expensive. At what point is consumer health compromised?

A second concern is when the mitigation itself creates potential hazards. A famous example of this category concerns the use of chlorine to kill microbial contaminants in drinking water. In the chlorination process minute amounts of hydrocarbons found in drinking water are converted to chlorinated hydrocarbons, known carcinogens. Acting on that information alone, one country immediately stopped chlorination of their water supplies and within a few weeks thousands of its citizens died of cholera. Precipitous engagement of the Precautionary Principle to protect the population from cancer had a large negative effect. A consideration of the harmful consequences of introducing a mitigation measure for one hazard only to encounter a far worse situation must be part of the analysis presented to a decision-maker.

In yet another situation, delaying protective action while targeting research at specific data gaps can result in better decisions than immediately implementing protective actions despite great uncertainty. This strategy also results in better targeting of mitigation measures for the greatest effect. Research on the biology of *Salmonella* Enteritidis in eggs furnished important information on the best ways to mitigate for this food hazard. Rapid response on an incomplete evaluation of the risk resulted in measures which mitigate up to 8 percent of the total risk. Further research showed

that very different measures were required to deal with the other portion of the risk.

These examples and many others like them are relevant to the present debates on the appropriate use of the Precautionary Principle. The debate will continue. The adage “better safe than sorry” might be supplemented with the one that says “first do no harm.” The Codex Alimentarius Commission is working to “build a common understanding of how to assess, appraise, manage and communicate risks that science is not yet able to evaluate fully, and avoid unwarranted recourse to the Precautionary Principle as a disguised form of protectionism.”

May the search be successful!

Nell Ahl would like to thank Linda Abbott for her input on this Director's Corner. It represents the views of Nell and Linda and is not to be construed as representing any official position of USDA.

Citations

(Codex Alimentarius) Commission Communication on Precautionary Principle. IP/00/96, Brussels, Belgium, February 2, 2000. From the WWW site: http://europa.eu.int/rapid/start/cgi/guesten.ksh?p_action.gettxt=gt&doc=IP/00/96|0 RAPID&lg=EN

John D. Graham. January 4, 2000. “Decision-Analytic Refinements of the Precautionary Principle,” IN Press, *Journal of Risk Research*.

Salmonella Enteritidis Risk Assessment for Shell Eggs and Egg Products. Final Report June 12, 1998 prepared for the U.S. Department of Agriculture Food Safety and Inspection Service by the *Salmonella* Enteritidis Risk Assessment Team. Available through WWW site: <http://www.fsis.usda.gov/ophs/risk/index.htm>

Risk Assessor in Profile: Dr. Mark Powell

ORACBA is pleased to feature Dr. Mark Powell in this issue of the newsletter. This is a special event since Mark has joined the staff of ORACBA as of March 12, 2000. Prior to joining ORACBA Mark was a Risk Analyst with the USDA Food Safety and Inspection Service (FSIS) Office of Public Health and Science, Epidemiology and Risk Assessment Division. Among his many projects while on staff at FSIS, Mark served as the leader of the FSIS team undertaking a risk assessment for *E. coli* O157:H7 in ground beef.

From September 1997 to May 1998, Mark was an American Association for the Advancement of Science Risk Science Fellow assigned first to ORACBA and later to FSIS. While at ORACBA, Mark's primary focus was on conservation programs, particularly with respect to manure management and food safety. He served ably on the

FSIS “core business process” re-engineering team, representing the interests and needs of risk analysis in FSIS.

Prior to Mark's association with USDA, he was a Fellow at the Resources for the Future Center for Risk Management, where he conducted research on the acquisition and use of science for regulatory decisionmaking in the environmental and sanitary and phytosanitary arenas. Previously, Mark worked at the U.S. Agency for International Development and the U.S. Environmental Protection Agency (EPA) Office of Research and Development. His experience at the EPA, as well as extensive research following his work there, is reflected in his book *Science at EPA*, recently published by Resources for the Future. It has achieved high critical acclaim in several major scientific

journals, including *Science*.

Mark has a unique academic background that makes him especially valuable as a risk analyst. These credentials include a B.S. in Natural Resource Management, an M.A. in Political Science, and a Ph.D. in Ecology from Rutgers University, New Brunswick, New Jersey. Mark is an active member of the American Association for the Advancement of Science and the Society for Risk Analysis.

When questioned, Mark listed two pet peeves regarding risk assessments. The first is that the separation of variability and uncertainty in risk assessment is an ideal to strive for, but in reality is often not achievable. Consider, for example, that

although a factor in a risk assessment model may be treated as representing pure variability, measurement error adds an unavoidable component of uncertainty to the residual or unexplained variability that is observed in any situation. The second is when he finds risk assessors using parametric techniques when non-parametric approaches are appropriate. An overarching process concern is the need to set the risk assessment agenda in anticipation of regulatory decisions so that policymakers have the information required to make informed judgments. ORACBA is pleased to have Mark on staff.

News of ORACBA

Quantitative Risk Assessment Course Completes First Presentation

The first trial presentation of a new course on "Quantitative Risk Assessment" came to a close on March 10, 2000. The course, "Quantitative Risk Assessment," sought to bridge the gap between the "Introduction to Risk Analysis" course and the "Advanced Quantitative Risk Assessment" course by providing students with a foundation in spreadsheet modeling techniques and probability theory. Students were introduced to quantitative modeling techniques, the use of probability distributions in Monte Carlo models, and Bayesian approaches to risk assessment. The participants were selected from among staff of the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) as a special group to help fashion the agenda for a permanent addition to the curriculum. The class was held on eight successive Friday afternoons in the Food and Drug Administration's computer training room. This

enabled students to have "hands on" experience using Excel and @Risk. Mark Walderhaug of the FDA's Center for Food Safety and Applied Nutrition, Rob McDowell of USDA's Animal and Plant Health Inspection Service, and Linda Abbott of USDA's Office of Risk Assessment and Cost-Benefit Analysis presented the course. The course was a learning experience for both students and instructors. Student feedback will be used to modify the course before its next offering later in the year.

2000 Risk Forums

Everyone is encouraged to take advantage of the opportunity provided by the expanded format for this year's Risk Forums. As stated in the Winter 2000 issue of the *ORACBA News*, the Risk Forum will continue to be held on the second Wednesday of each month in Room 107A, Jamie L. Whitten Federal Building, 12th & Jefferson Drive, SW, Washington, DC. In addition to the morning presentation and discussion from 10:00 a.m. -

11:30 a.m., an afternoon workshop has been added from 1:00 p.m. - 4:00 p.m. in Room 0768, South Building, 1400 Independence Avenue, SW, Washington, DC. For further information, contact Jennifer Callahan at: (202) 720-8024 or e-mail jcallahan@oce.usda.gov.

2000 Risk Forum Calendar

April 12	Dr. Mark Tumeo/Risk Assessment Center of Excellence at Cleveland State University
May 10	Dr. Richard Lowrance/Evaluation of Riparian Buffers in the USDA Conservation Buffer Initiative
June 14	Dr. Tsegaye Habtemariam/Modeling and Risk Assessment
July 12	Dr. Christopher Frey/Quantitative Analysis of Variability and Uncertainty
August	NO FORUM
September 13	Dr. Peter Cowan/Epidemiologist and Risk Assessors: Do we speak the same language when it comes to food safety?

USDA/ORACBA Partnership With FDA's JIFSAN and the Graduate School, USDA

Shortly after two courses, a primer on risk assessment and an advanced course, were piloted in the summer of 1996, USDA and FDA formed a partnership whose goal was to develop further training opportunities in risk analysis. In 1996 the USDA Graduate School was convinced to offer the course, Introduction to Risk Assessment. Eighteen months after the first course was offered through the

Graduate School, Richard Williams (FDA) and Nell Ahl (USDA) developed a draft curriculum designed to meet the ongoing requests for additional courses. Again the Graduate School joined the partnership by agreeing to offer a certificate program based upon that curriculum. This summer the certificate program is being brought one step closer to reality by the addition of two courses, Quantitative Risk Assessment and Ecological Risk Assessment, to be offered through the Graduate School. The dates and locations of these courses are as follows:

Ecological Risk Assessment

June 6 - 8, 2000

APHIS, USDA

Training Rooms 3 & 4

4700 River road riverdale, MD

Quantitative Risk Assessment

July 10 - 14, 2000

APHIS, USDA

Computer Training Room

4700 River Road

Riverdale, MD

For further information concerning these courses, contact Anne Lloyd Hufstader, Graduate School, USDA at (202) 314-3411.

Web Site Address

Over the last few months ORACBA has received a number of calls asking where we are—they can't find our Web site. After investigation, it was discovered that due to a change in the department's naming scheme our Web address had changed. The correct address is www.usda.gov/oce/oracba. Also, we ask your patience over the next few months as we work on developing a new Web site. If you have ideas or suggestions for the new improved Web site, please contact me at jcallahan@oce.usda.gov or (202) 720-8024. All suggestions are welcome and appreciated.

January Risk Forum: Dr. George E. Taylor

Dr. George E. Taylor, Jr., Professor of Biology at George Mason University in Fairfax, Virginia, presented an "Ecological Risk Characterization of Low Dose, High Toxicity Herbicides" at the January 12 Risk Forum. The acetolactate synthases inhibiting herbicides affect plants by suppressing biosynthesis of certain amino acids (made also by some microbes). Animals do not synthesize these amino acids, however, and therefore are largely unaffected by these herbicides. Thus, the herbicides as a class are highly phytotoxic at very low doses (application rates 0.5 lb/A), yet have low toxicity to humans. There has been rapid appearance of resistant weed biotypes, within 5 years in some cases. The risk characterization is considered preliminary because there are so few data on this subject in the peer-reviewed, open literature data, and most of this is limited to at-risk non-target species in both managed (e.g., crops) and unmanaged (e.g., woodlots, surface waters) ecosystems. A modeling approach was used to estimate exposures in the near field (< 300 meters); estimated concentrations approached 10^{-4} to 10^{-6} Moles. Based on the available literature describing lab or field experiments, the EC_{50} s for individual species of vascular plants, microbes or algae are estimated to be approximately 10^{-6} Moles, and sensitivity is shared at the whole-plant (including yield), microbial, and molecular levels. Since exposure estimates can exceed that of the median EC_{50} by at least an order of magnitude, there is a reasonable probability that sensitive non-target species in managed and unmanaged landscapes

within 300 m of a routine field application of these herbicides are at risk. There is no evidence that effects extend beyond the near field to a regional scale, and there are no data to support an economic valuation of the impact of the chemicals on non-target plants. First principles of the ecotoxicological behavior of the acetolactate synthases herbicides in the soil-plant-atmosphere continuum suggest that these herbicides are highly mobile in the environment and that they are non-uniformly distributed because the chemicals have low vapor pressure but high solubility in water. Furthermore, the half-life of the chemicals in the environment ranges from days to perhaps a year or so. Based upon first principal analysis and the literature (which indicates accumulation in the biosphere), the most probable sites of accumulation may be near-surface soil and plant tissues. Accumulation of the herbicides in roots may result in concentrations in the tissues that are up to 10X those in soil solution. Following translocation to the leaves, transpiration may result in accumulation of the chemicals in cells near the guard cells. The consequences at broader (spatial and temporal) ecological scales of this proposed non-uniform distribution of acetolactate synthases herbicides in the environment have not been investigated, although several stand-level functions are likely to be at risk, including belowground processes, ecosystem biogeochemistry, community structure and function, phylloplane microorganisms, and phloem loading and translocation.

February Risk Forum: Dr. Stan Kaplan

On Wednesday, February 9, Dr. Stan Kaplan of Bayesian Systems, Inc. presented the February Risk Forum, entitled "An Introduction to TRIZ, the Russian Theory of Inventive Problem Solving." Dr. Kaplan began his seminar by challenging the

audience to solve the problem of filling chocolate bottles with raspberry syrup. The syrup must be heated in order to pour it; however, pouring hot syrup into chocolate bottles causes the bottles to melt. This apparently unsolvable problem set the

stage for Dr. Kaplan to discuss TRIZ, a Russian acronym for the Theory of Solution of Inverse Problems. The solution to the chocolate bottle problem was to freeze individual servings of the syrup and then form the chocolate bottle around the frozen syrup. TRIZ is a method for organizing inventive problems. TRIZ takes a specific inventive problem and abstracts it into a category of problems for which an abstract solution is available and then translates the abstract solution into a specific solution for the specific problem. It presents a methodology for solving problems rather than using

a trial and error approach. Dr. Kaplan discussed the relationship between TRIZ and quantitative risk assessment and decision theory. Anticipatory failure determination (AFD), a subset of TRIZ, was the focus of Dr. Kaplan's afternoon workshop. While risk assessment addresses the question of "What can go wrong?" AFD changes the question into "How can I make something go wrong?" The workshop provided participants with the opportunity to apply AFD to two different problems. More information about Dr. Kaplan and TRIZ can be found at his website, bayesian.com.

March Risk Forum: Dr. Laurence Madden

On March 8, Dr. Madden of Ohio State University presented the March Risk Forum, entitled "Assessing the Plant Disease Outcome of an Introduced Plant Pathogen: Disease Invasion and Persistence." Dr. Madden's seminar addressed the epidemiological consequences of an accidental introduction of a plant pathogen. He began his discussion by framing the question in the form of a risk assessment model relating risk to the probability of pathogen arrival, establishment, survival, hazard, and containment. He then contrasted the primary and secondary spread of the pathogen and suggested that secondary spread may be of more concern because spores in infectious plants are spread to other plants through rain or wind. Primary spread can be thought of as a "simple-interest phase," while secondary spread is considered the "compound-interest phase." Dr. Madden illustrated how the SEIR model, a standard model used by epidemiologists, could be used to estimate whether a pathogen could successfully invade and persist in a crop. The components of the

SEIR model are susceptible, disease-free plant hosts (S), plant disease intensity in the latent or exposed state (E), plant disease intensity in the infectious stage (I), and plant disease in the removed state (R). The epidemiological model can be used to determine what combinations of model parameters (i.e., infection rates, latent periods, inoculum depletion rates) result in persistent pathogen populations. The SEIR model identified data gaps in the experimental literature, suggesting areas of research that need particular attention. One such gap was biological data on the production of inoculum. Dr. Madden's research is relevant not only for plant pathologists, but also to a broader audience interested in the spread of microbial pathogens. The mechanisms of spread important in the invasion of plant pathogens are also important factors in the spread of other types of microbial pathogens. To learn more about Dr. Madden's research, visit his web page at www.ag.ohio-state.edu/~plantdoc/faculty/madden.html.

Risk Calendar

April 2000

April 10-12 – ASTM 10th Symposium on Environmental Toxicology and Risk Assessment, Science, Policy and Standardization–Implications for Environmental Decisions. For more information, contact Bruce Greenberg at (519) 888-4567 x3209, fax (519) 746-0614, e-mail greenber@sciborg.uwaterloo.ca.

April 12 – ORACBA Risk Forum, "Risk Assessment Center of Excellence at Cleveland State University," Dr. Mark Tumeo, Center for Environmental Science, Technology and Policy, Cleveland State University. The Forum will be held from 10:00 a.m. - 11:30 a.m., in Room 107A, Whitten Building, 12th & Jefferson Drive, SW, Washington, DC, followed by a workshop from 1:00 p.m. - 4:00 p.m. in Room 0769, South Building, 1400 Independence Avenue, SW, Washington, DC. For more information, call (202)

720-8022.

April 14-15 – North Atlantic Chapter of the Society of Environmental Toxicology and Chemistry, 6th Annual Meeting, Partnerships for Environmental Protection and Sustainability: Research, Policy, and Education, Newport Harbor Hotel and marina, Newport, RI. For more information contact Kay Ho at (401) 782-3196, e-mail ho.kay@epamail.epa.gov or Cornelia Mueller at (401) 847-4210, e-mail cornelia@mtg.saic.com.

April 18-19 – Waste Management Conference: Management of Swine and Poultry Waste, Jackson, MS. For more information, see <http://www.msstate.ars.usda.gov/1stcall.htm>.

May 2000

May 10 – ORACBA Risk Forum, “Evaluation of Riparian Buffers in the USDA - Conservation Buffer Initiative,” Dr. Richard Lowrance, Ecologist, Agricultural Research Service, Southeast Watershed Research Lab, U.S. Department of Agriculture. The Forum will be held from 10:00 a.m. to 11:30 a.m. in Room 107A, Whitten Building, 12th & Jefferson Drive, SW, Washington, DC, followed by a workshop from 1:00 p.m. - 4:00 p.m. in Room 0768, South Building, 1400 Independence Avenue, SW, Washington, DC. For more information, call (202) 720-8022.

May 10-11 – Communicating Science: Taking the Risk, A Superworkshop On Risk Communication for Scientists, Communicators, and Administrators, Agricultural Communicators in Education and the U.S. Department of Agriculture’s Cooperative State Research, Education and Extension Service, Orange County Conference Center, Orlando, FL. For more information, visit <http://www.aceweb.org/superworkshop2000/superworkshop.html>

May 11-13 – The Expanding Role for Agriculture in the 21st Century, National Agricultural Biotechnology Council, Clarion Hotel, Orlando, FL. For more information on the program, contact Bill Brown, NAB12 Chair, at (352) 392-1728 or e-mail wfb@gnv.ifas.ufl.edu. To register, contact July Kite at (352) 392-1784.

May 21-25 – SETAC Third World Congress and SETAC Europe 10th Annual Meeting, Global Environmental Issues in the 21st Century: Problems, Causes and Solutions, Brighton, United Kingdom. Topics will include Science and Policies Needed To Achieve Sustainable Ecosystems Regionally and Globally, Extrapolation of Environmental Processes Across Temporal, Spatial and Biological Scales, and Linkages Between Ecosystem Condition and Human Health. For a copy of the First Announcement and First Call for Papers, contact SETAC Europe, Av. E. Mounier 83, Box 3, 1200 Brussels, Belgium, phone +32-2-772-72-81, fax +32-2-770-53-86, or e-mail setac@ping.be.

May 22-25 — Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds. Monterey Conference Center,

Monterey, CA. For more information, contact The Conference Group at (800) 783-6338 or (614) 424-5461, fax (614) 488-5747, e-mail conferencegroup@compuserve.com.

June 2000

June 6-8 – *Ecological Risk Assessment* course sponsored by USDA and FDA through the Graduate School, USDA. For more information or to register, contact Ann-Lloyd Hufstader at (202) 314-3411.

June 14 – ORACBA Risk Forum, “Modeling and Risk Assessment,” Dr. Tsegaye Habtemariam, Biological Information Management Service, School of Veterinary Medicine, Tuskegee University. The Forum will be held from 10:00 a.m. to 11:30 a.m. in Room 107A, Whitten Building, 12th & Jefferson Drive, SW, Washington, DC, followed by a workshop from 1:00 p.m. - 4:00 p.m. in Room 0768, South Building, 1400 Independence Avenue, SW, Washington, DC. For more information, call (202) 720-8022.

June 21-24 – Year 2000 Symposium on Risk Analysis, Society for Risk Analysis, Arlie House, McLean, VA. To begin an international dialogue on the state of the field and new directions, focusing on selected key issues associated with methods and practice in risk analysis. Will address how to build connections between SRA and other professional groups working in risk analysis-related areas and how to bridge the gap between risk analysts/researchers and risk managers/regulators. For more information contact the Secretariat at (703) 790-1745 or e-mail SRA@BurkInc.com.

June 26-30 – Introduction to Risk Sciences and Public Policy, Johns Hopkins University, School of Hygiene and Public Health, East Baltimore Campus. Summer intensive course. For more information, call Johns Hopkins University, School of Hygiene and Public Health at (410) 614-6200.

July 2000

July 10-14 – *Quantitative Risk Assessment* course sponsored by USDA and FDA through the Graduate School, USDA. For more information or to register, contact Ann-Lloyd Hufstader at (202) 314-3411.

July 11 – ORACBA Risk Forum, “Quantitative Analysis of Variability and Uncertainty,” Dr. Christopher Frey, Department of Engineering, North Carolina State University. The Forum will be held from 10:00 a.m. to 11:30 a.m. in Room 107A, Whitten Building, 12th & Jefferson Drive, SW, Washington, DC, followed by a workshop from 1:00 p.m. - 4:00 p.m. in Room 0768, South Building, 1400 Independence Avenue, SW, Washington, DC. For more information, call (202) 720-8022.

August 2000

August 6 - 9 – 87th Annual Meeting, International Association of Food Protection, Hilton Atlanta, Atlanta, GA. For more information, call (800) 369-6337 or (515) 276-3344, fax (515) 276-8655, or see www.foodprotection.org.

September 2000

September 10 - 12 – Beltsville Symposium XXIV, Healthy Animals 2000, Friends of Agriculture Research, Beltsville, MD. For more information, see <http://www.barc.usda.gov/fmod/symposium>.

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